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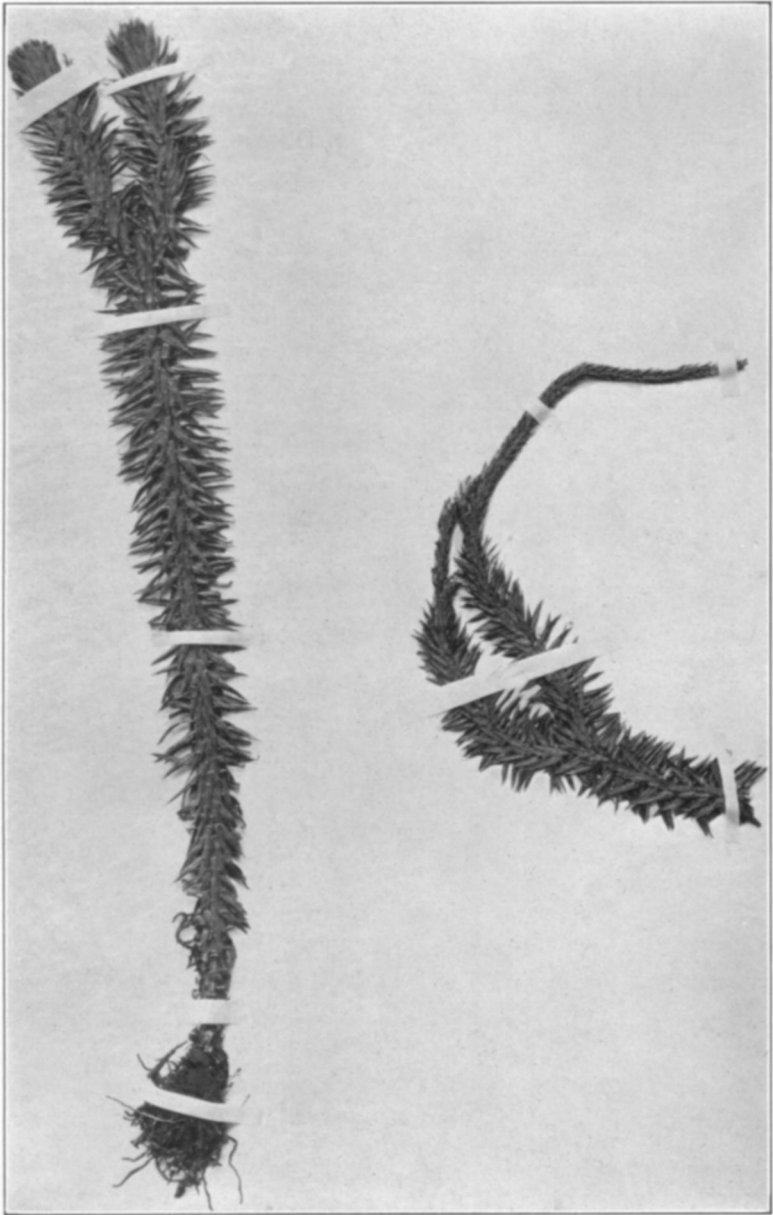
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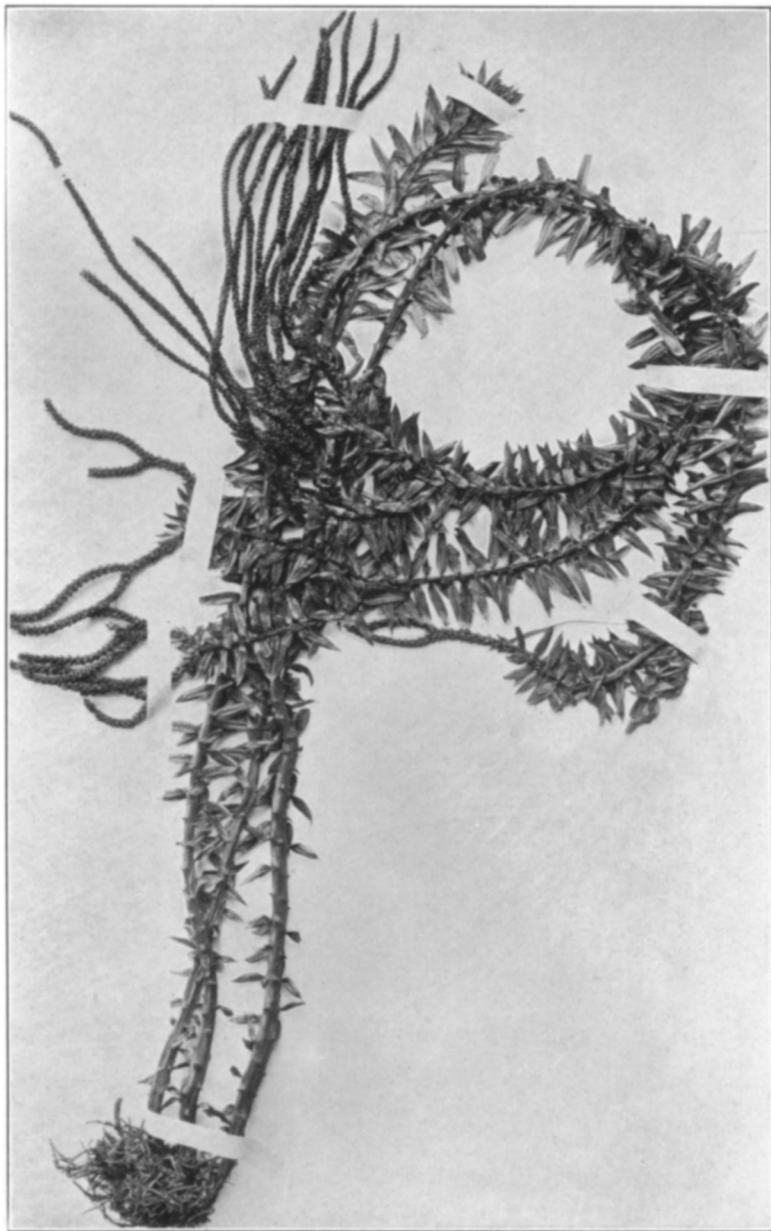
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LYCOPODIUM NUTANS BRACK



LYCOPodium PHYLLANTHUM Hook. & Arn.

A taxonomic study of the Pteridophyta of the Hawaiian Islands—IV

WINIFRED J. ROBINSON

(WITH PLATES I AND 2)

LYCOPODIALES

Terrestrial or epiphytic plants with spores produced in sporangia borne in the axils of scale-like leaves.

Homosporous.

Sporangia 1-celled.

LYCOPODIACEAE.

Sporangia 2-3-celled.

PSILOTACEAE.

Heterosporous.

SELAGINELLACEAE.

LYCOPODIACEAE

Plants with upright or procumbent stems; leaves small, simple, crowded, in 2-several ranks upon the stem; sporangia in the axils of sporophylls, which may be leaf-like or scale-like, these in some species aggregated to form terminal strobili; spores yellow, numerous.

LYCOPODIUM L. Sp. Pl. 1100. 1753

Characters of the family.

Type species: *Lycopodium clavatum* L.

Vegetative leaves uniform.

Sporophylls not aggregated in strobili; stems usually erect.

Stems tufted, often reddish; leaves coriaceous, entire,
6-8-ranked.

Leaves linear-lanceolate, patent, 8-ranked.

L. erubescens.

Leaves ovate-lanceolate, appressed, 6-ranked.

L. Haleakalae.

Stems not tufted, green; leaves membranaceous, finely
serrate, 4-6-ranked.

L. serratum.

Sporophylls aggregated in strobili; stems erect or pendulous.

Leaves membranaceous, 3-ranked.

L. Phlegmaria.

Leaves coriaceous, in more than 3 ranks.

Leaves 8-ranked; strobili simple, usually recurved.

L. cernuum.

Leaves 4-6-ranked; strobili often branched, not recurved.

Leaves linear-lanceolate, 6-ranked; sporophylls lanceolate, decreasing somewhat in size from base to apex of strobilus.

L. nutans.

Leaves lanceolate, 4-6-ranked; sporophylls broadly ovate, uniform in size.

L. phyllanthum.

Vegetative leaves not uniform.

Stems dorsi-ventral.	<i>L. volubile.</i>
Stems not dorsi-ventral.	
Sporophylls aggregated in terminal strobili.	<i>L. venustulum.</i>
Sporophylls not aggregated in terminal strobili.	<i>L. polytrichoides.</i>

LYCOPODIUM SERRATUM Thunb. Fl. Jap. 341. 1784

Lycopodium varium Mann, Proc. Am. Acad. 7: 221. 1866. Not Swartz.

Lycopodium sulcinervium Spring, Mém. Acad. Roy. Brux. 15: 39. 1842.

Lycopodium javanicum Sw. Syn. Fil. 175. 1810.

Lycopodium sargassifolium Liebm. Öfvers. Vid. Selsk. Förh. 1847: 41. 1847.

TYPE LOCALITY: Japan.

DISTRIBUTION: On tree trunks in forests at 700 m.-2200 m. elevation; Hawaiian Islands, Japan, India, Philippine Islands, Sumatra, Polynesia, Mexico.

ILLUSTRATIONS: Thunb. Fl. Jap. pl. 38. 1784. Hook. & Grev. Ic. Fil. pl. 37. 1874.

SPECIMENS EXAMINED: Hawaii, *Robinson 218 V*; Oahu, *Heller 2904 C*; *Forbes 1036 BM*; *Forbes BM*; *Knudsen B*; *Robinson 196 V*; Kauai, *Heller 2687 C*; *Knudsen B*; *Robinson 414 V*; *816 V*.

Hillebrand's *L. serratum dentatum* (Hilleb. Fl. Haw. Is. 643. 1888) is represented by one small specimen from Lanai in the Berlin Herbarium; his *L. serratum subintegrum* by a single sterile shoot at Berlin. Forbes's specimen (no number) collected between Punahou and Kaipaupau, Oahu, corresponds with Hillebrand's description of the latter as to size and reddish color.

LYCOPODIUM ERUBESCENS Brack. Fil. U. S. Expl. Exped. 320. 1854

TYPE LOCALITY: Mount Haleakala, Maui, Hawaiian Islands.

DISTRIBUTION: In wet lands, at 2,000 m. elevation, Maui and Kauai, Hawaiian Islands.

ILLUSTRATION: Brack. Fil. U. S. Expl. Exped. pl. 45. 1854.

SPECIMENS EXAMINED: Hawaiian Islands, *Wilkes Expedition 1 B* (type); *Wilkes Expedition C*; K.

This very compact form is well suited to the xerophytic conditions of the high altitudes where it is found.

LYCOPODIUM HALEAKALAE Brack. Fil. U. S. Expl. Exped. 312.
pl. 45. 1854

TYPE LOCALITY: Eeka, W. Maui, Hawaiian Islands.

DISTRIBUTION: Type locality.

ILLUSTRATION: Brack. Fil. U. S. Expl. Exped. *pl. 45.* 1854.

SPECIMENS EXAMINED: *Hillebrand 153 B.*

Hillebrand's specimen is small, but its obtuse, serrated leaves, with an incurved apex, and its greater rigidity distinguish it from *L. erubescens* Brack. and *L. compactum* Hook., which are its nearest allies.

Pritzel, E. & P. Nat. Pflanzenfam. 1⁴: 593. 1900, gives both *L. Haleakalae* and *L. erubescens* as varieties of *L. suberectum* Lowe, but they differ from each other sufficiently to establish their origin from different species at least, if change of habitat should prove that their alpine characters are not specific.

LYCOPODIUM PHLEGMARIA L. Sp. Pl. 1101. 1753

TYPE LOCALITY: India.

DISTRIBUTION: India, Australia, Pacific Islands, Mauritius.

ILLUSTRATIONS: Breyne, Exot. Cent. *pl. 92.* 1678. E. & P. Nat. Pflanzenfam. 1⁴: 600. *f. 377.* 1900.

SPECIMENS EXAMINED: Maui, *Mann B.*

The specimen examined is more slender than the Indian forms, but the material available does not warrant the establishment of a new species.

LYCOPODIUM CERNUUM L. Sp. Pl. 1103. 1753

Lycopodium curvatum Gaud. Voy. Freyc. Bot. 284. 1828.

TYPE LOCALITY: India.

DISTRIBUTION: Common in thickets at the edge of forests in the tropics.

ILLUSTRATIONS: Dill. Hist. Musc. *pl. 63.* 1741. E. & P. Nat. Pflanzenfam. 1⁴: 603. *f. 379.* 1900.

SPECIMENS EXAMINED: Maui, *Robinson 398 V*; Oahu, *Forbes BM*; *Hillebrand B*; *Robinson 53 V*; *95 V*; *197 V*; *Seemann 1705 B*; Kauai, *Heller 2596 C*; *Knudsen 186 B*; Hawaiian Islands, *Hillebrand B*; *Miss Sessions C.*

The specimens of *L. cernuum* in the Hillebrand collection in

the Berlin Herbarium are there separated into two species, *L. crassifolium* and *L. capillaceum*, the former of which is the more robust. It is difficult, however, to determine constant characters which may be termed diagnostic, whether one tries to separate the plants into two species as at Berlin or into seven with Müller (Bot. Zeit. 19: 161. 1861).

LYCOPODIUM NUTANS Brack. Fil. U. S. Expl. Exped. 327. 1854

TYPE LOCALITY: Oahu, Hawaiian Islands.

DISTRIBUTION: On trees, at 600 m.-1,000 m. elevation, rare, Hawaiian Islands.

ILLUSTRATIONS: Brack. Fil. U. S. Expl. Exped. *pl.* 46. 1854.
PLATE I.

SPECIMENS EXAMINED: Oahu, Nuuanu Valley, *Hillebrand B*; *Robinson 199 V*; W. Maui, Wailua Valley, *Hillebrand B*.

The conspicuous difference between the slender fertile portion which terminates the branch and the broad sterile portion with its stiff coriaceous linear-lanceolate leaves, gives the distinguishing feature which separates *L. nutans* from *L. squarrosum* Forst. In the latter, the transition is gradual between the sterile and fertile areas.

Brackenridge in describing *L. nutans* as a new species closely related to *L. phyllanthum* Hook. & Arn. says: "This is one of the most robust species of the genus. It is very well distinguished from the preceding (*L. phyllanthum*) by its stouter stem, and its thick, nodding spikes; the leaves on the stems also are more crowded and the scales of the spikes are of considerably greater length."

LYCOPODIUM PHYLLANTHUM Hook. & Arn. Bot. Beech. 102. 1832

Lycopodium pachystachyon var. β *phyllanthon* Spring, Mém. Acad. Brux. 24: 29. 1848.

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: Pendulous on trees; Hawaiian Islands, Tahiti, Samoa, Borneo, Java, India.

ILLUSTRATION: PLATE 2.

SPECIMENS EXAMINED: Hawaii, *Robinson 263 V*; Maui, *Robinson 389 V*; Oahu, *Heller 2182 C*; *Hillebrand B*; *Knudsen 29 B*;

Kuntze C; *Robinson* 445 V; Lauai, *Hillebrand* B; Hawaiian Is., *Forbes* BM; *Lindley* C; *Wilkes Expedition* C.

L. phyllanthum has very nearly related species in the Indian *L. macrostachys* Spring, Mém. Acad. Brux. 24: 30. 1848, and in the Philippine specimens *Williams* 573 C and *Williams* 2916 C. In most of the Hawaiian specimens, the diameter of the fertile portion is greater than it is in the Indian or Philippine plants.

In none of the specimens examined by the writer were the upper sporophylls of the strobilus "barren and larger, approaching the form of true leaves" as described by Hooker and Arnott (l. c.) but in the Philippine specimens mentioned above the strobilus was somewhat foliaceous.

LYCOPodium VOLUBILE Forst. Prod. 86. 1781

TYPE LOCALITY: Australia.

DISTRIBUTION: Australia, New Zealand, Hawaiian, Viti, and Society Islands.

SPECIMENS EXAMINED: Hawaiian Islands, *Menzies* K.

This species is interesting because it resembles *Selaginella* in dimorphic sterile leaves, but has the fertile spike of a true *Lycopodium*. *Menzies* is the only collector known to have found it, and his specimen probably came from Mauna Kea, Hawaii.

LYCOPodium VENUSTULUM Gaud. Voy. Freyc. Bot. 283. pl. 22.
1828

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: At elevations of 800 m.-1200 m., Hawaiian Islands.

ILLUSTRATION: Gaud. Voy. Freyc. Bot. pl. 22. 1828.

SPECIMENS EXAMINED: Oahu, *Forbes* BM; Hawaiian Is., *Hillebrand* B; 128 K; *Wilkes Expedition* B; 24 C; K; 26 C.

One of the specimens collected by the Wilkes Expedition, 26 C, is reduced in size and has fewer branches from the horizontal stem proportionately than the normal form, *Wilkes* 24 C. This doubtless grew at a higher elevation or in a more exposed locality than is usual for the species. *Hillebrand* makes it a variety, *L. venustum* var. *herpeticum*, but it is not worthy of specific rank.

LYCOPODIUM POLYTRICHOIDES Kaulf. Enum. Fil. 6. 1824

TYPE LOCALITY: Oahu, Hawaiian Islands.

DISTRIBUTION: On trees, at 600–1,000 m. elevation, Hawaiian Islands.

SPECIMENS EXAMINED: Oahu, *Chamisso* B (type); Oahu, Mopala Valley, Kaala Mts., *Forbes* BM; Waiolau Valley, *Forbes* BM; Konahuanui, *Heller* C; Kaala Mts., *Hillebrand* B; *Martens* B; Molokai, *Hillebrand* B; Kauai, *Knudsen* 34 B; Hawaiian Islands, *Hillebrand* 594 B; 598 B; *Menzies* K; *Wilkes Expedition* K.

Chamisso's type is a slender plant about 15 cm. high, while *Hillebrand's* specimen from Molokai is much branched and about 40 cm. high. The others range between these. All, however, agree in the open angles of the branching, and in the many-ranked aculeate leaves, which bear sporangia in the last two or three divisions of the stem.

PSILOTACEAE

Represented in the Hawaiian Islands by the single genus *Psilotum*.

PSILOTUM Sw. Syn. Fil. 187. 1806

Epiphytic or occasionally terrestrial plants; stems upright; roots fleshy; leaves small, scale-like, the sterile simple, the fertile bifid; sporangia borne in the axils of the leaves, 3-celled, opening by three valves from the apex; spores minute, yellow.

Type species: *Lycopodium nudum* L.

Stems triangular; sterile leaves aculeate, minute.

P. nudum.

Stems flattened; sterile leaves obtuse.

P. complanatum.

PSILOTUM NUDUM (L.) Griseb. Abh. Kön. Gesell. Wiss. Göttingen 7: 278. 1857

Lycopodium nudum L. Sp. Pl. 1100. 1753.

Hoffmannia aphylla Willd. in Römer & Ust. Mag. Bot. 6: 17. 1789.

Bernhardia dichotoma Willd. in Schrift. Acad. Erfurt. 1802: 11. 1802.

Psilotum triquetrum Sw. Syn. Fil. 187. 1806.

Psilotum oahuensis Müller, Bot. Zeit. 14: 238. 1856.

TYPE LOCALITY: Jamaica, B. W. I.

DISTRIBUTION: On ground and on trees, in tropical countries.

ILLUSTRATIONS: Schkuhr, Krypt. Gew. *pl.* 165*b.* 1809; Plum. Foug. Am. *pl.* 170 *f. a.* 1705; Dill. Hist. Musc. *pl.* 64. *f. 4.* 1741 (Dillenius probably never saw the specimen but seems to have copied Plumier's figure).

SPECIMENS EXAMINED: Hawaii, *Robinson* 264 V; Maui, *Robinson* 313 V; 351 V; Oahu, *Eschscholz* K; *Wilkes Expedition* N; *Heller* 1989 C; K; N; *Mann & Brigham* 140 N; *Seemann* 1723 K; Hawaiian Is., *Wilkes Expedition* C; N; *Lindley* C; *Macrae* K.

PSILOTUM COMPLANATUM Sw. Syn. Fil. 188. 1806

Muscus clavatus Bauhin. Pinax. 360. 1671.

Lycopodium Sabinae-facie Dill. Hist. Musc. 445. 1741.

Lycopodium digitatum Dill. Hist. Musc. 448. 1741.

Lycopodium complanatum L. Sp. Pl. 1104. 1753.

Bernhardia ramulosa Müller, Bot. Zeit. 14: 222. 1856.

TYPE LOCALITY: Jamaica, B. W. I.

DISTRIBUTION: On trees, West Indies, Malaysia, Polynesia, and Hawaiian Islands.

ILLUSTRATIONS: Dill. Hist. Musc. *pl.* 59. *f. 3.* 1741. Sw. Syn. Fil. *pl.* 4. *f. 5.* 1806. Schkuhr, Krypt. Gew. *pl.* 165*b.* 1809.

SPECIMENS EXAMINED: Oahu, *Robinson* 11 V; 20 V; *Wilkes Expedition* N; Kaala Mts., *Wilkes Expedition* N; *Heller* 2216 C; K; N; Ex Herb. Hooker C; *Hillebrand* 118 K; *Macrae* C.

SELAGINELLACEAE

Plants with upright or procumbent, usually dorsi-ventral, dichotomous stems, one branch exceeding the other in growth; leaves uniform or dimorphous, in the latter case forming a mosaic, the lateral leaves extending horizontally from either side of the stem, the intermediate leaves closely applied to the stem; sporophylls borne at the ends of the branches usually forming strobili, in which the few macrosporangia are in the axils of the basal sporophylls, the more numerous microsporangia in the axils of the terminal sporophylls.

SELAGINELLA Beauv. Prod. 101. 1805

Characters of the family.

Type species: *Lycopodium selaginoides* L.

Vegetative leaves uniform; spores rough.

S. deflexa.

Vegetative leaves not uniform; spores smooth.

- Leaves imbricated; stems 20 cm. or less in length. *S. arbuscula.*
 Leaves not imbricated; stems more than 20 cm. long.
 Branching flabellate; megasporangia 3-valved. *S. Menziesii*
 Branching pinnate or apparently so; megasporangia 2-valved. *S. Springii.*

SELAGINELLA DEFLEXA Brack. Fil. U. S. Expl. Exped. 332. 1854

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: Rare, on trees, at elevations of 600–2,000 m., Hawaiian Islands.

ILLUSTRATION: Brack. Fil. U. S. Expl. Exped. *pl.* 45. 1854.

SPECIMENS EXAMINED: Maui (Mt. Eeka) *Hillebrand* B; C; Molokai (Wailau) *Hillebrand* B; Kauai, *Hillebrand* K; *Knudsen* B; *Johnson* B.

S. deflexa is easily distinguished from *Lycopodium serratum* by its backwardly directed spinulose leaves and the shortness of the leaves at the base of the stem which give the shoot the appearance of an inverted cone.

SELAGINELLA ARBUSCULA Spring, Mém. Acad. Brux. 24: 183. 1848

Lycopodium arbuscula Kaulf. Enum. Fil. 19. 1824.

Lycopodium pennigerum Gaud. Voy. Freyc. Bot. 288. 1828.

TYPE LOCALITY: Oahu, Hawaiian Islands.

DISTRIBUTION: Hawaiian Islands.

SPECIMENS EXAMINED: Hawaii, *Hillebrand* B; *Robinson* 269 V; Oahu, *Diell* C; *Heller* 1993 C; (Nuuanu) *Hillebrand* B; (Kahaua) *Hillebrand* B; *Meyen* B; (Hillebrand's Glen) *Robinson* 121 V; 184 V; Hawaiian Is., *Gaudichaud* B; *Macrae* K; *Wilkes Expedition* C; Ex Herb. Kew. C.

The small size of the plants and the closely crowded leaves distinguish *S. arbuscula* from the other species usually found growing with it.

SELAGINELLA MENZIESII Spring, Mém. Acad. Brux. 24: 185. 1848

Lycopodium Menziesii Hook. Bot. Misc. 2: 390. 1831.

Selaginella flabellata Underw. Minn. Bot. Stud. 14: 793. 1896.
 Not Spring.

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: In mountain forests, Hawaiian, Samoan, and Fiji Islands.

ILLUSTRATION: Hook. & Grev. Ic. Fil. *pl.* 200. 1831.

SPECIMENS EXAMINED: Maui, *Robinson* 723 V; Oahu, *Douglas* 30 K; *Forbes* 1016 BM; (Makaha Valley) BM; (Konahuanui) BM; (Kaipaupau) BM; *Hillebrand* B; *Menzies* K; *Wilkes Expedition* 5 C; Kauai, *Heller* 2499 C; 2558 C.

The darker color, and proportionately broader form distinguish this from *S. Springii*, notwithstanding the close relationship existing between *S. Menziesii*, *S. flabellata*, and *S. Springii*.

SELAGINELLA SPRINGII Gaud. Voy. Bonite Bot. Crypt. 340. 1846
Selaginella Menziesii Baker, Fern Allies 97. 1887. Not Spring,
Mém. Acad. Brux. 24: 185. 1848.

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: In moist localities, at elevations of 600–800 m., Hawaiian Islands.

ILLUSTRATION: Gaud. Voy. Bonite Bot. Crypt. pl. 12. 1846–9.

SPECIMENS EXAMINED: Maui (Waihee) *Hillebrand* B; (Lahaina) *Hillebrand* B; *Robinson* 704 V; Molokai (Wailau) *Hillebrand* B; Oahu, *Forbes* BM; *Chamisso* B; *Heller* 2009 C; 2180 C; *Robinson* 522 V; 528 V; Ex Herb. Mt. Holyoke College C.

Baker (Fern Allies 97. 1887) and Hieronymus (Nat. Pflanzenfam. 1⁴: 678. 1901) both speak of the intergrading forms between *S. Springii* and *S. Menziesii*. The latter, however, recognizes *S. Springii* as a species distinct from *S. Menziesii* though closely related to it. It would not be remarkable if crosses had frequently occurred between these two forms which grow upon wet rocks where there is every facility for such hybridization.

The teeth at the base of the anterior margin of the stem leaves are longer than those of the apical portion, but hardly slender enough to be regarded as cilia as Gaudichaud figures them.

SPECIES INQUIRENDA

SELAGINELLA PARVULA Hilleb. Fl. Haw. Is. 648. 1888

TYPE LOCALITY: Hawaiian Islands.

DISTRIBUTION: Oahu (Nuuanu Valley), Hawaiian Islands.

Hillebrand in a footnote to his description of *S. parvula* suggests that it may be a young form of *S. arbuscula*, a suggestion which seems very probably true, from the close similarity of the two plants and the fact that only the one collection of the material has been made.